

300mA LDO REGULATOR

NO. EA-236-120613

OUTLINE

The RP114x Series are CMOS-based voltage regulator ICs with high output voltage accuracy, low supply current, low dropout, and high ripple rejection. Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, resistors for setting output voltage, a short current limit circuit, a chip enable circuit, and so on.

RP114x features a minimum input voltage from 1.4V and the output voltage, which can be set from 0.8V to 3.6V (in 0.1V step). The output voltage of these ICs is internally fixed.

These ICs perform with low dropout voltage due to built-in transistor with low ON resistance. Low supply current and a chip enable function prolong the battery life of each system. The ripple rejection, line transient response and load transient response of the RP114x Series are excellent, thus these ICs are very suitable for the power supply for hand-held communication equipment.

Since the packages for these ICs are DFN(PLP)1010-4, SC-88A, SOT-23-5, therefore high density mounting of the ICs on boards is possible.

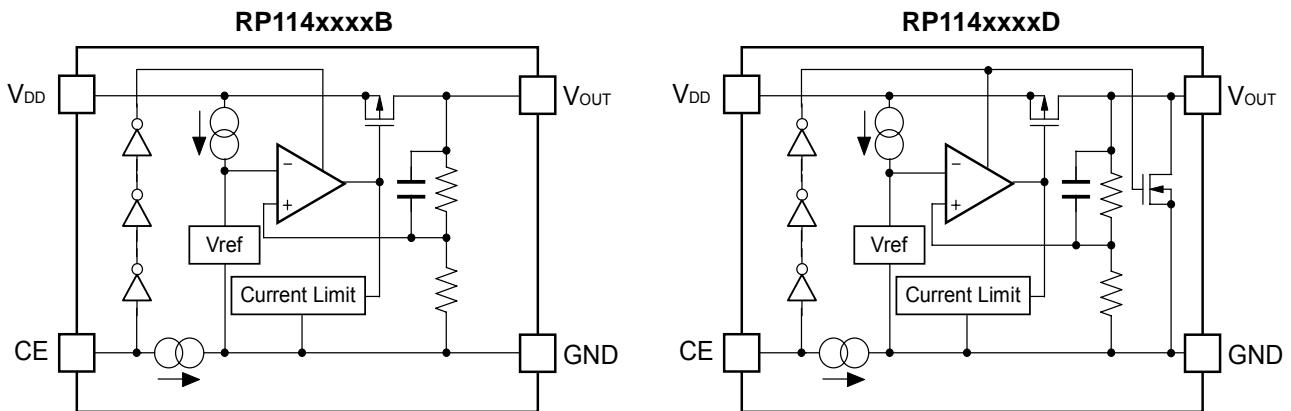
FEATURES

- Supply Current Typ. 50 μ A
- Standby Current Typ. 0.1 μ A
- Input Voltage Range 1.4V to 5.25V
- Output Voltage Range 0.8V to 3.6V (0.1V steps)
(For other voltages, please refer to MARK INFORMATIONS.)
- Output Voltage Accuracy $\pm 1.0\%$ ($V_{SET} > 2.0V$, $T_{opt} = 25^\circ C$)
- Temperature-Drift Coefficient of Output Voltage Typ. $\pm 80\text{ppm}/^\circ C$
- Dropout Voltage Typ. 0.25V ($I_{OUT} = 300\text{mA}$, $V_{SET} = 2.8V$)
- Ripple Rejection Typ. 75dB ($f = 1\text{kHz}$)
- Line Regulation Typ. 0.02%/V
- Packages DFN(PLP)1010-4, SC-88A, SOT-23-5
- Built-in Fold Back Protection Circuit Typ. 60mA (Current at short mode)
- Ceramic capacitors are recommended to be used with this IC 1.0 μ F or more

APPLICATIONS

- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.

BLOCK DIAGRAMS



SELECTION GUIDE

The set output voltage, auto discharge function, and package, etc. for the ICs can be selected at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP114Kxx1*-TR	DFN(PLP)1010-4	10,000 pcs	Yes	Yes
RP114Qxx2*-TR-FE	SC-88A	3,000 pcs	Yes	Yes
RP114Nxx1*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The set output voltage can be selected from 0.8V(08) to 3.6V(36) in 0.1V steps.

The second decimal point of the voltage is described as below.

1.25V: RP114K121*5-TR, RP114Q122*5-TR-FE, RP114N121*5-TR-FE

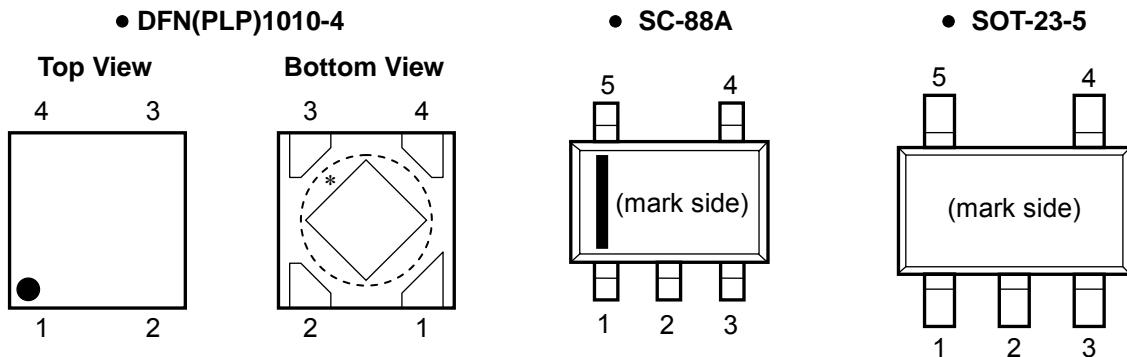
1.85V: RP114K181*5-TR, PR114Q182*5-TR-FE, RP114N181*5-TR-FE

2.85V: RP114K281*5-TR, PR114Q282*5-TR-FE, RP114N281*5-TR-FE

* : The auto discharge function at off state is options as follows.

- (B) without auto discharge function at off state
- (D) with auto discharge function at off state

PIN CONFIGURATIONS



PIN DESCRIPTIONS

• DFN(PLP)1010-4

Pin No	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	V_{DD}	Input Pin

*) Tab is GND level. (They are connected to the reverse side of this IC.)

The tab is better to be connected to the GND, but leaving it open is also acceptable.

• SC-88A

Pin No	Symbol	Pin Description
1	CE	Chip Enable Pin ("H" Active)
2	NC	No Connection
3	GND	Ground Pin
4	V_{OUT}	Output Pin
5	V_{DD}	Input Pin

• SOT-23-5

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin ("H" Active)
4	NC	No Connection
5	V_{OUT}	Output Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	6.0	V
V_{CE}	Input Voltage (CE Pin)	−0.3 to 6.0	V
V_{OUT}	Output Voltage	−0.3 to $V_{IN}+0.3$	V
I_{OUT}	Output Current	400	mA
P_D	Power Dissipation (DFN(PLP)1010-4)*	400	mW
	Power Dissipation (SC-88A)*	380	
	Power Dissipation (SOT-23-5)*	420	
T_{opt}	Operating Temperature Range	−40 to 85	°C
T_{stg}	Storage Temperature Range	−55 to 125	°C

*) For Power Dissipation, please refer to PACKAGE INFORMATION.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

POWER DISSIPATION (DFN(PLP)1010-4)

This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

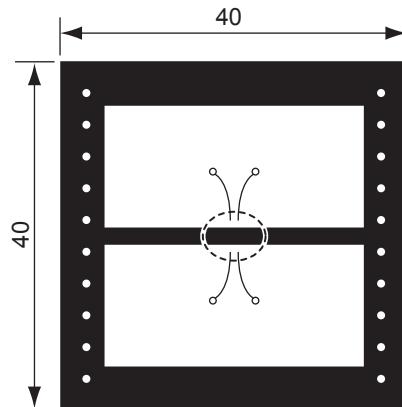
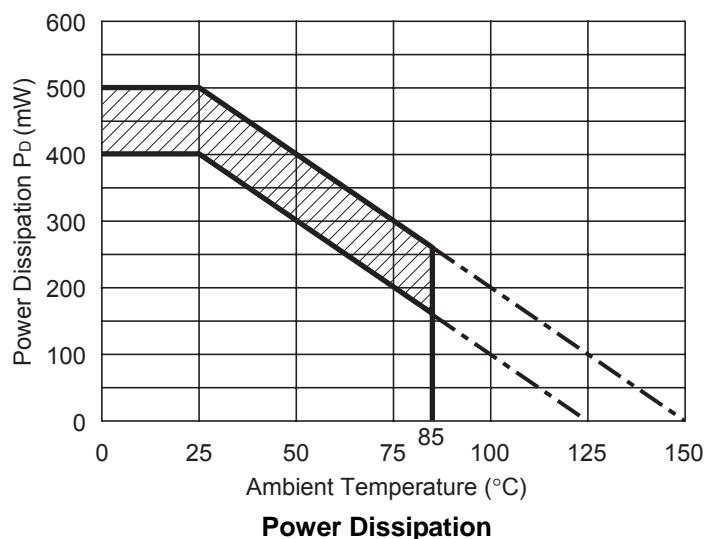
Measurement Conditions

Measurement Conditions		Standard Land Pattern
Environment	Mounting on Board (Wind velocity=0m/s)	
Board Material	Glass cloth epoxy plastic (Double sided)	
Board Dimensions	40mm × 40mm × 1.6mm	
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%	
Through-holes	φ0.54mm × 24pcs	

Measurement Results

($T_{opt}=25^{\circ}\text{C}$, $T_{max}=125^{\circ}\text{C}$)

Measurement Results		(T _{case} = 25°C, T _{jmax} = 125°C)
		Standard Land Pattern
Power Dissipation	400mW	
Thermal Resistance	$\theta_{ja} = (125 - 25°C) / 0.4W = 250°C/W$	
Thermal Resistance	$\theta_{jc} = 67°C/W$	



Measurement Board Pattern

○ IC Mount Area (Unit: mm)

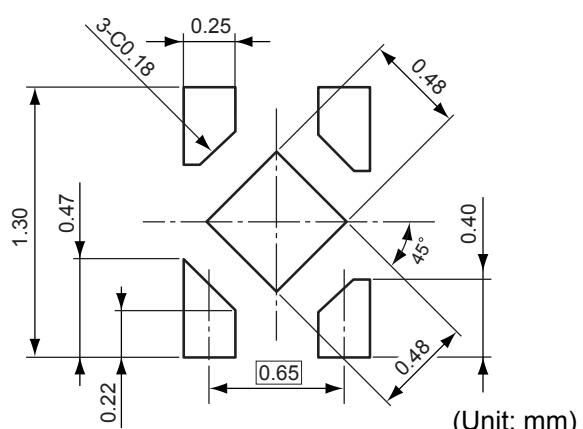
RECOMMENDED LAND PATTERN

The above graph shows the Power Dissipation of the package based on $T_{jmax}=125^{\circ}\text{C}$ and $T_{jmax}=150^{\circ}\text{C}$. Operating the IC in the shaded area in the graph might have an influence it's lifetime.

Operating time must be within the time limit described in the table below, in case of operating in the shaded area.

Operating time	Estimated years*
13.000hrs	9years

*The volume is calculated on the supposition that operating four hours/day.



POWER DISSIPATION (SC-88A)

This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

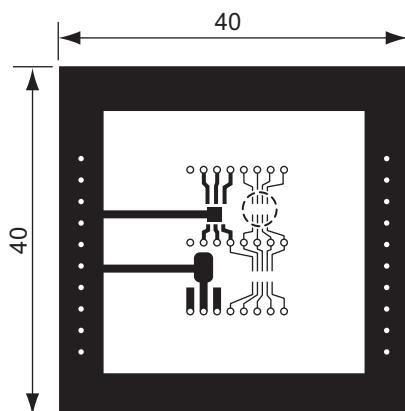
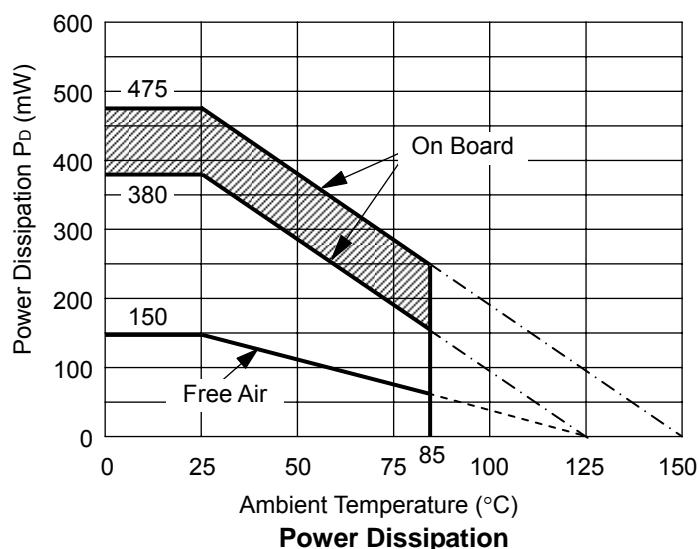
Measurement Conditions

Standard Land Pattern	
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50%, Back side : Approx. 50%
Through-holes	φ0.5mm × 44pcs

Measurement Results

($T_{opt}=25^{\circ}\text{C}$, $T_{jmax}=125^{\circ}\text{C}$)

	Standard Land Pattern	Free Air
Power Dissipation	380mW	150mW
Thermal Resistance	$\theta_{ja}=(125-25^{\circ}\text{C})/0.38\text{W}=263^{\circ}\text{C/W}$	$\theta_{ja}=(125-25^{\circ}\text{C})/0.15\text{W}=667^{\circ}\text{C/W}$
Thermal Resistance	$\theta_{jc}=75^{\circ}\text{C/W}$	-



Measurement Board Pattern
 IC Mount Area (Unit: mm)

The above graph shows the Power Dissipation of the package based on $T_{jmax}=125^{\circ}\text{C}$ and $T_{jmax}=150^{\circ}\text{C}$.

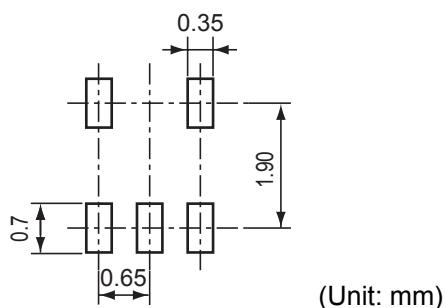
Operating the IC in the shaded area in the graph might have an influence it's lifetime.

Operating time must be within the time limit described in the table below, in case of operating in the shaded area.

Operating time	Estimated years*
13,000hrs	9years

*The volume is calculated on the supposition that operating four hours/day.

RECOMMENDED LAND PATTERN



POWER DISSIPATION (SOT-23-5)

This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board.

This specification is based on the measurement at the condition below:

(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

Measurement Conditions

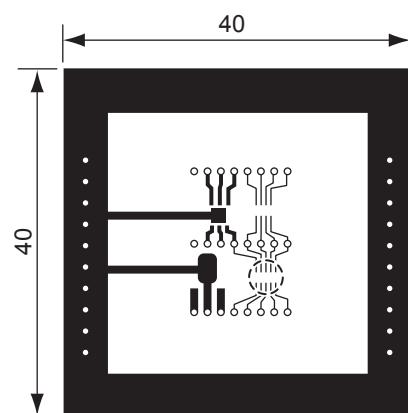
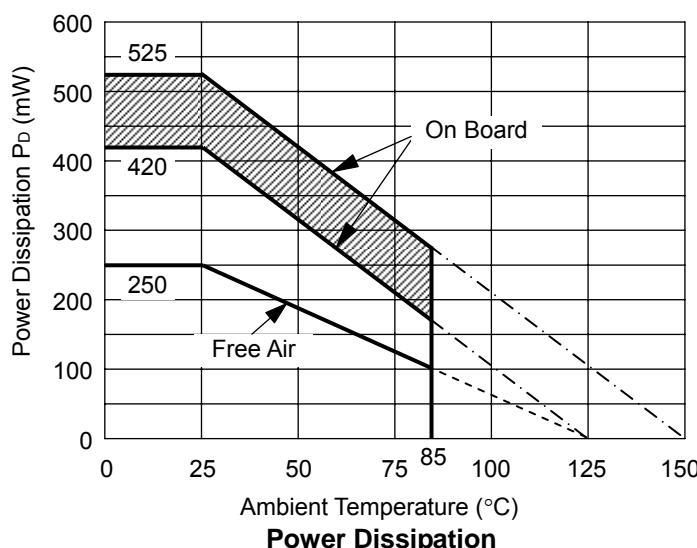
Standard Land Pattern	
Environment	Mounting on Board (Wind velocity=0m/s)
Board Material	Glass cloth epoxy plastic (Double sided)
Board Dimensions	40mm × 40mm × 1.6mm
Copper Ratio	Top side : Approx. 50% , Back side : Approx. 50%
Through-holes	φ0.5mm × 44pcs

Measurement Results

($T_{opt}=25^{\circ}\text{C}$,

$T_{jmax}=125^{\circ}\text{C}$)

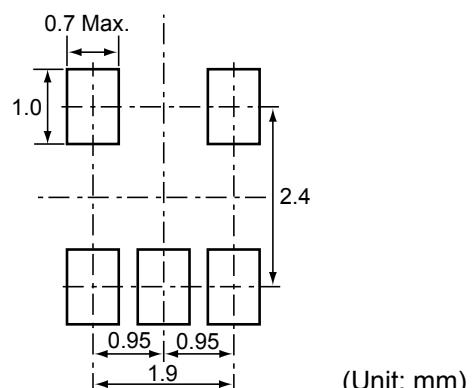
	Standard Land Pattern	Free Air
Power Dissipation	420mW	250mW
Thermal Resistance	$\theta_{ja}=(125-25^{\circ}\text{C})/0.42\text{W}=238^{\circ}\text{C/W}$	400°C/W



Measurement Board Pattern

○ IC Mount Area (Unit: mm)

RECOMMENDED LAND PATTERN



The above graph shows the Power Dissipation of the package based on $T_{jmax}=125^{\circ}\text{C}$ and $T_{jmax}=150^{\circ}\text{C}$.

Operating the IC in the shaded area in the graph might have an influence it's lifetime.

Operating time must be within the time limit described in the table below, in case of operating in the shaded area.

Operating time	Estimated years*
13,000hrs	9years

*The volume is calculated on the supposition that operating four hours/day.

ELECTRICAL CHARACTERISTICS

• RP114x

$V_{IN}=V_{SET}+1.0V$ ($V_{SET} > 1.5V$), $V_{IN}=2.5V$ ($V_{SET} \leq 1.5V$), $I_{OUT}=1mA$, $C_{IN}=C_{OUT}=1.0\mu F$, unless otherwise noted.

V_{SET} is Set Output Voltage.

The specification in is checked and guaranteed by design engineering at $-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$.

$T_{opt}=25^{\circ}C$

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	$T_{opt}=25^{\circ}C$	$V_{SET} > 2.0V$	$\times 0.99$		$\times 1.01$ V
			$V_{SET} \leq 2.0V$	-20		+20 mV
		$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$	$V_{SET} > 2.0V$	0.97		1.03 V
			$V_{SET} \leq 2.0V$	-60		+60 mV
I_{OUT}	Output Current		300			mA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	$1mA \leq I_{OUT} \leq 300mA$		15	40	mV
V_{DIF}	Dropout Voltage	Refer to the following table.				
I_{SS}	Supply Current	$I_{OUT}=0mA$		50	75	μA
$I_{standby}$	Standby Current	$V_{CE}=0V$		0.1	1.0	μA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	$V_{SET}+0.5V \leq V_{IN} \leq 5.25V$ ($V_{IN} \geq 1.4V$)		0.02	0.10	%/V
RR	Ripple Rejection	$f=1kHz$, Ripple 0.2Vp-p $V_{IN}=V_{SET}+1V$, $I_{OUT}=30mA$ (In case that $V_{SET} \leq 2.0V$, $V_{IN}=3V$)		75		dB
V_{IN}	Input Voltage *		1.4		5.25	V
$\Delta V_{OUT}/\Delta T_{opt}$	Output Voltage Temperature Coefficient	$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$		± 80		ppm / $^{\circ}C$
I_{SC}	Short Current Limit	$V_{OUT}=0V$		60		mA
I_{PD}	CE Pull-down Current			0.3		μA
V_{CEH}	CE Input Voltage "H"		1.0			V
V_{CEL}	CE Input Voltage "L"				0.4	V
en	Output Noise	$BW=10Hz$ to $100kHz$, $I_{OUT}=30mA$		75		μV_{rms}
R_{LOW}	Low Output Nch Tr. ON Resistance (of D version)	$V_{IN}=4.0V$, $V_{CE}=0V$		50		Ω

*) The maximum Input Voltage of the ELECTRICAL CHARACTERISTICS is 5.25V. In case of exceeding this specification, the IC must be operated on condition that the Input Voltage is up to 5.5V and the total operating time is within 500hrs.

All of units are tested and specified under load conditions such that $T_j \approx T_{opt}=25^{\circ}C$ except for Output Noise, Ripple Rejection, Output Voltage Temperature Coefficient.

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

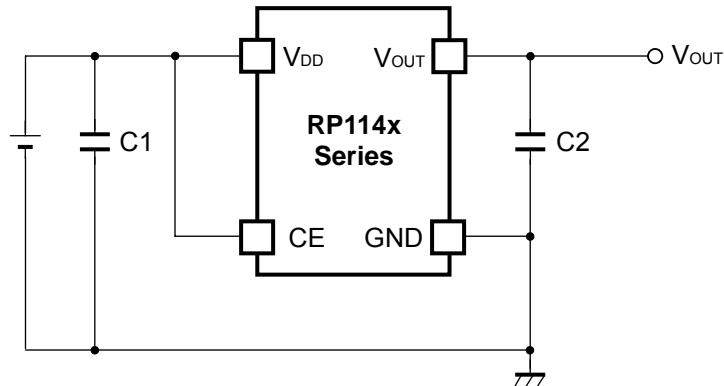
● Dropout Voltage by Set Output Voltage

Topt=25°C

Set Output Voltage V _{SET} (V)	Dropout Voltage V _{DIF} (V)		
	Condition	Typ.	Max.
V _{SET} =0.8	I _{OUT} =300mA	0.560	0.720
V _{SET} =0.9		0.510	0.650
1.0 ≤ V _{SET} < 1.2		0.460	0.590
1.2 ≤ V _{SET} < 1.4		0.390	0.500
1.4 ≤ V _{SET} < 1.7		0.350	0.440
1.7 ≤ V _{SET} < 2.1		0.300	0.390
2.1 ≤ V _{SET} < 2.5		0.260	0.340
2.5 ≤ V _{SET} < 3.0		0.250	0.300
3.0 ≤ V _{SET} ≤ 3.6		0.220	0.290

■ The specification in is checked and guaranteed by design engineering at -40°C ≤ Topt ≤ 85°C.

TYPICAL APPLICATIONS



(External Components)

C2 Ceramic 1.0 μ F MURATA: GRM155B31A105KE15

TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor C2 with 1.0 μ F or more and good ESR (Equivalent Series Resistance).

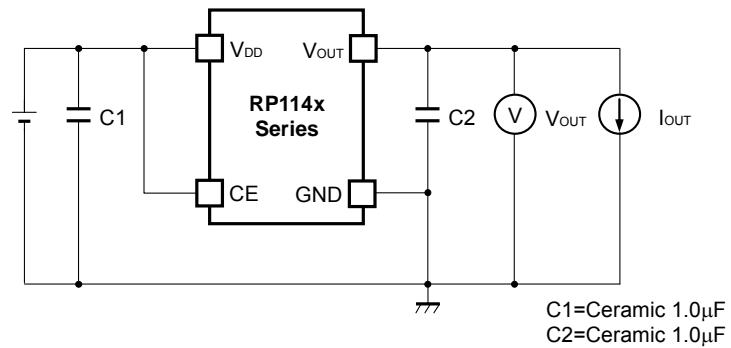
(Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

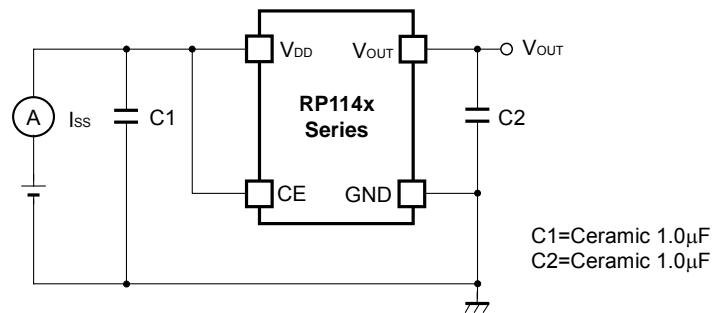
Make V_{DD} and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 with a capacitance value as much as 1.0 μ F or more between V_{DD} and GND pin, and as close as possible to the pins.

Set external components, especially the output capacitor C2, as close as possible to the ICs, and make wiring as short as possible.

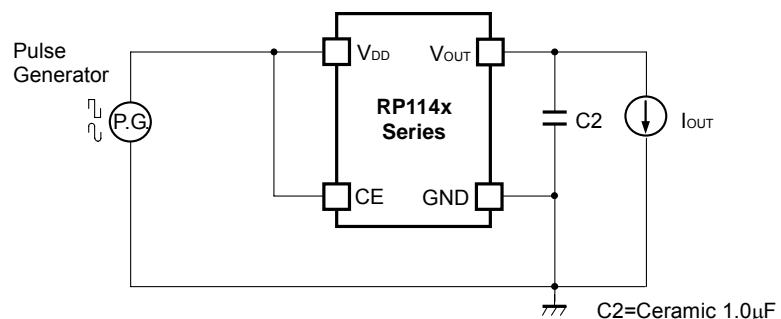
TEST CIRCUITS



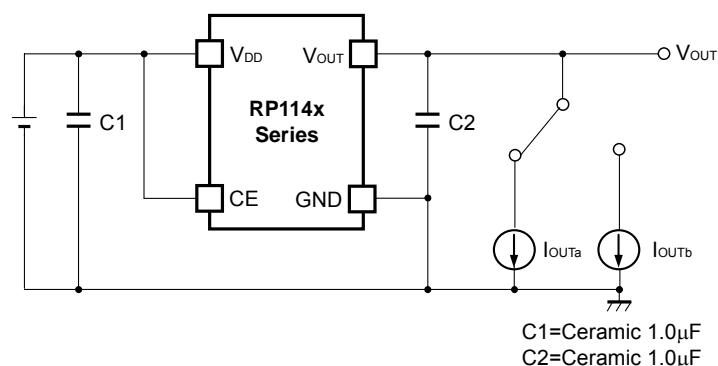
Basic Test Circuit



Test Circuit for Supply Current



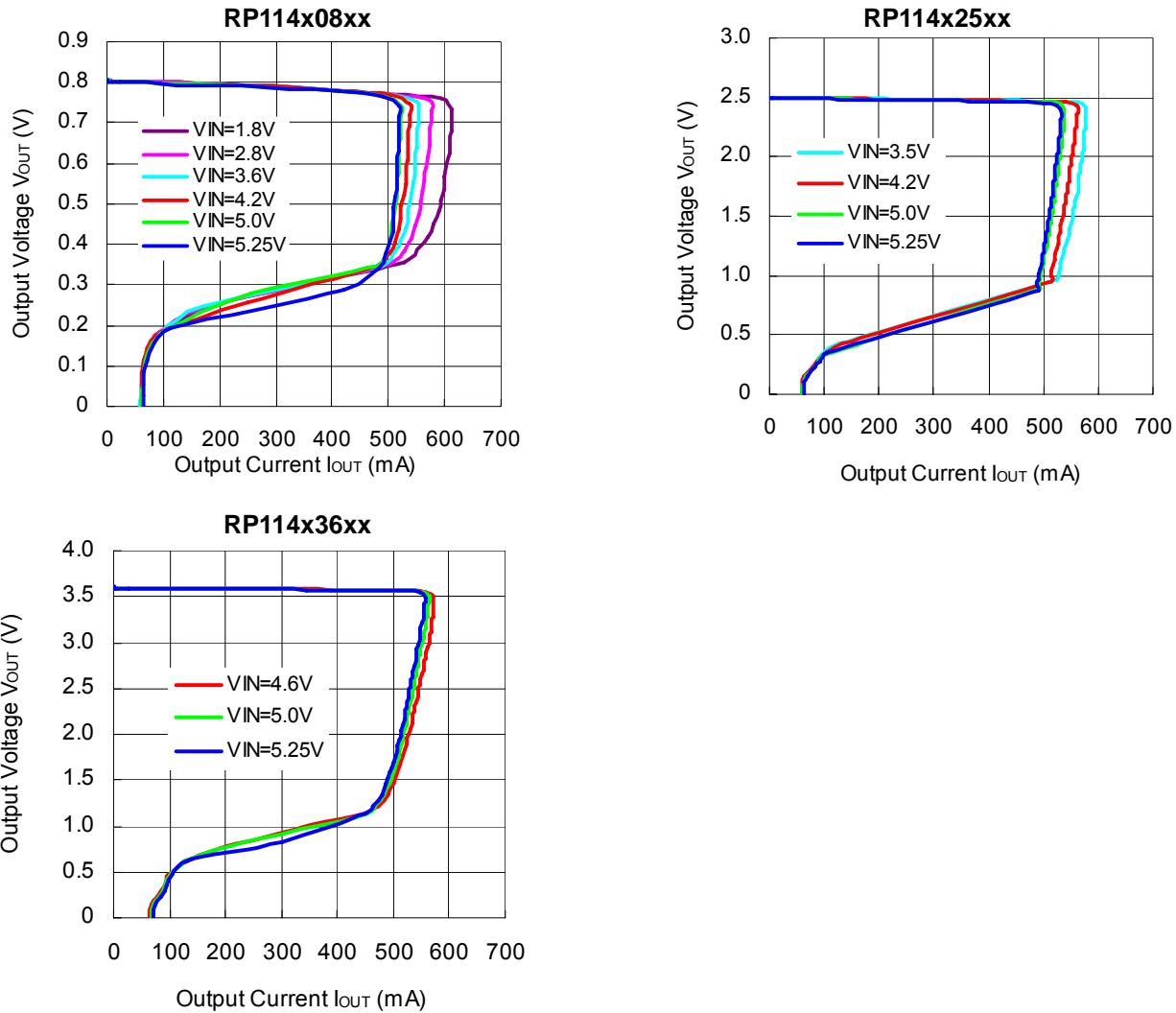
Test Circuit for Ripple Rejection



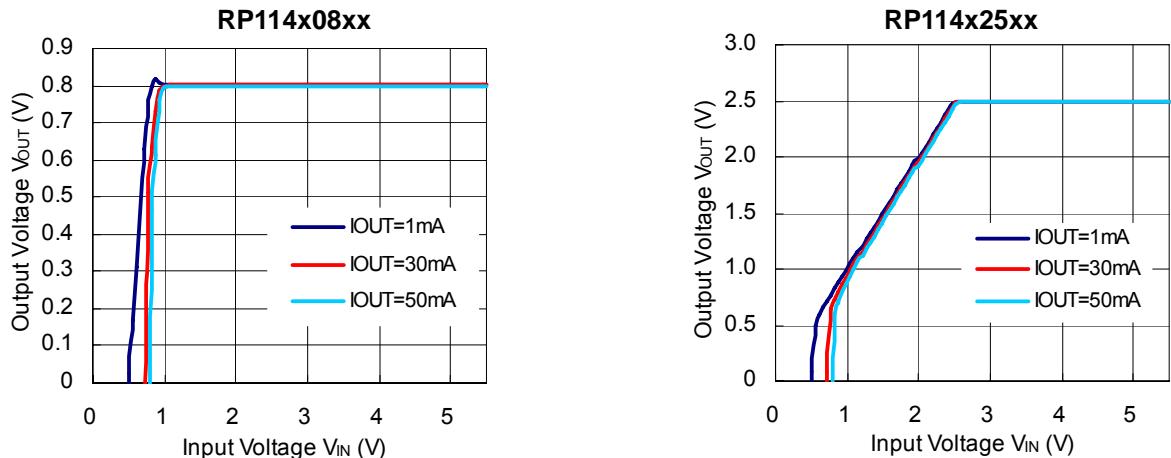
Test Circuit for Load Transient Response

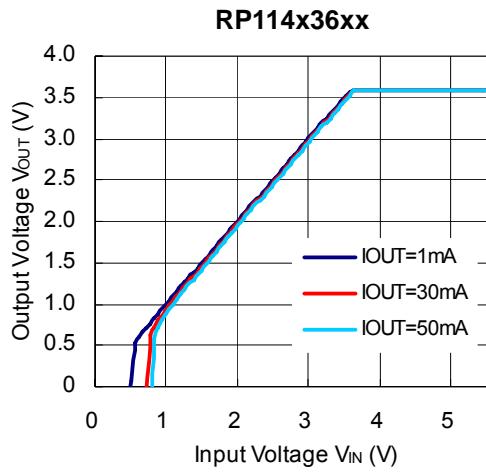
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (C1=1.0 μ F, C2=1.0 μ F, T_{opt}=25°C)

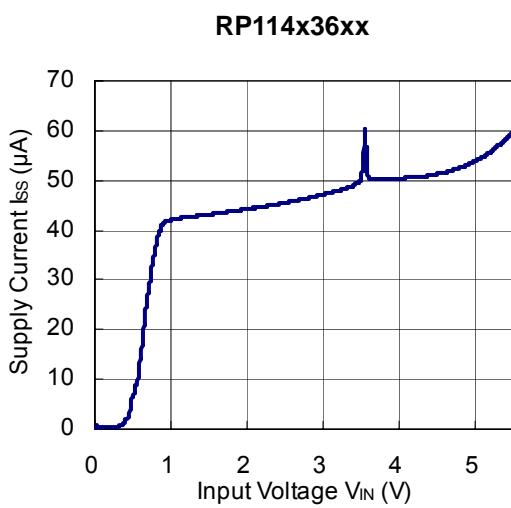
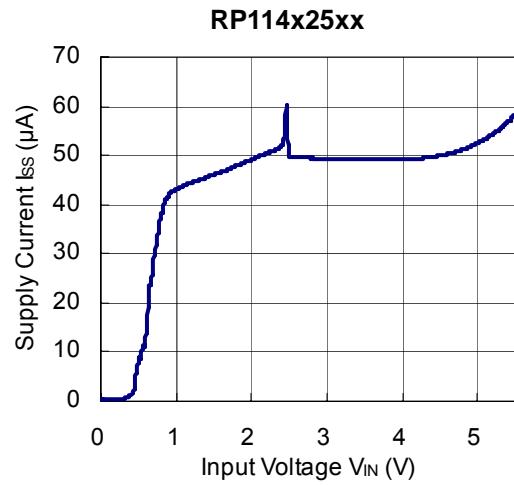
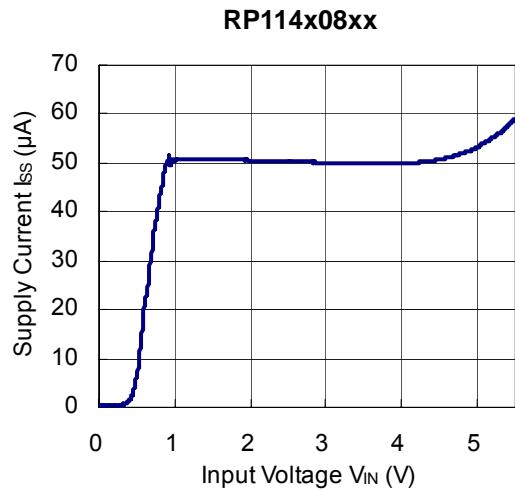


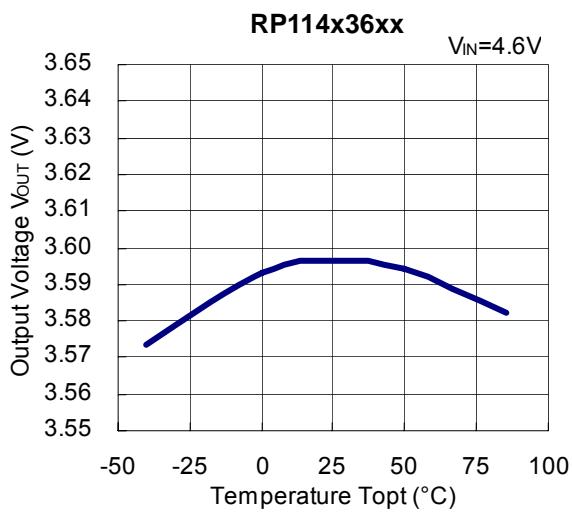
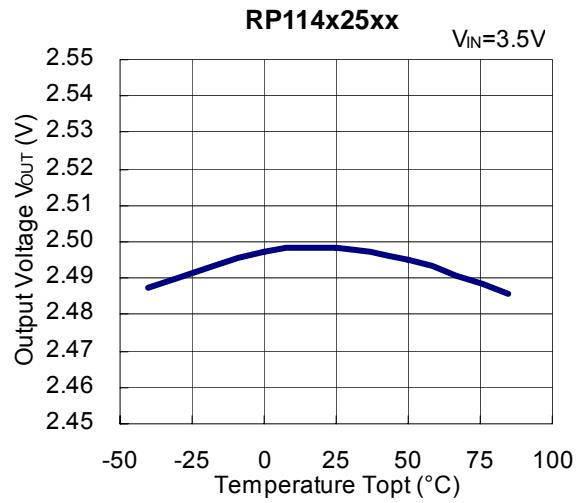
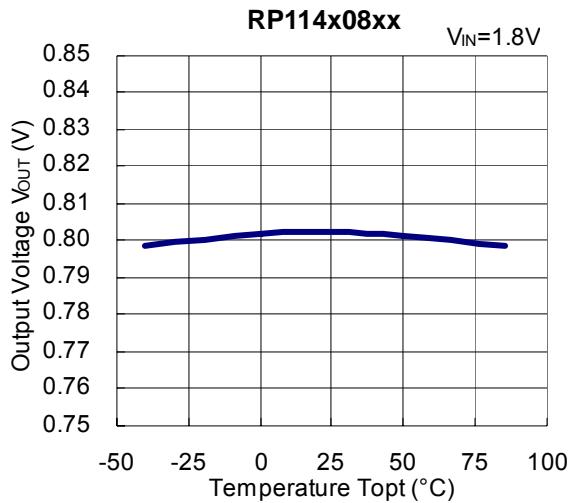
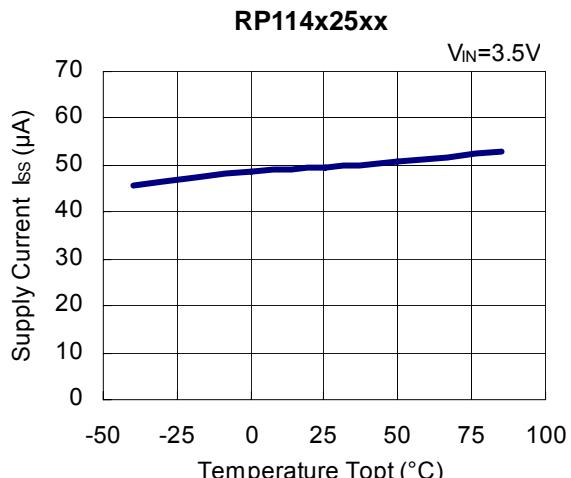
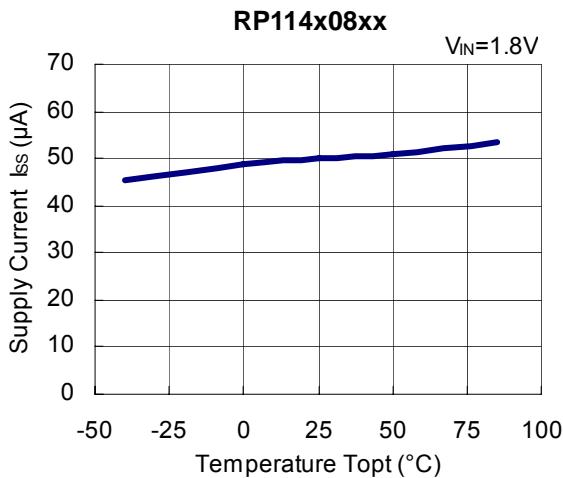
2) Output Voltage vs. Input Voltage (C1=1.0 μ F, C2=1.0 μ F, T_{opt}=25°C)

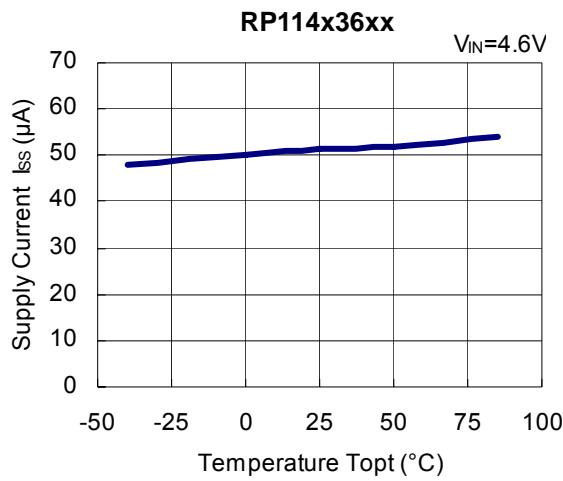




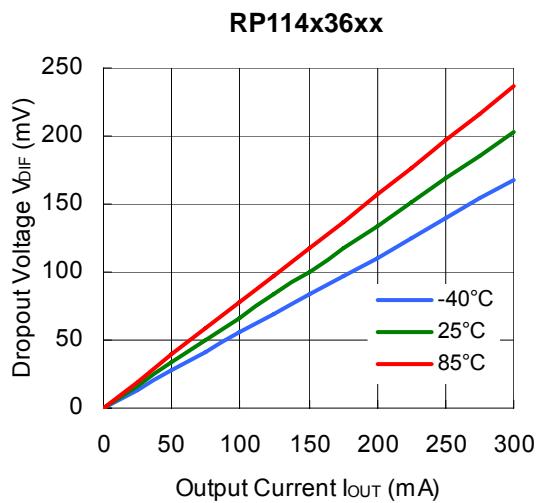
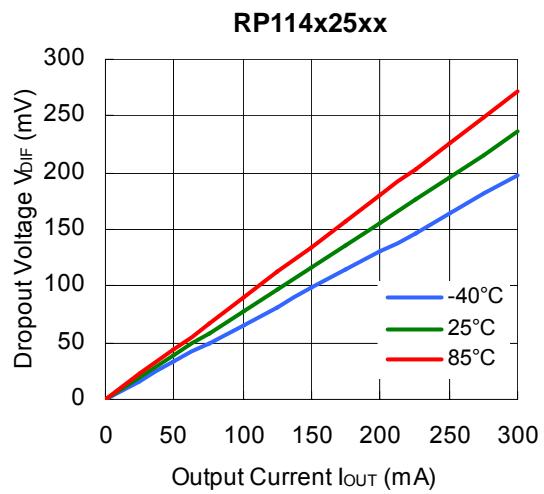
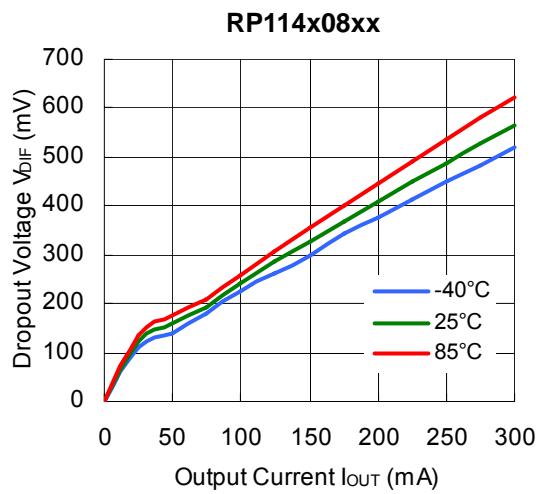
3) Supply Current vs. Input Voltage ($C1=1.0\mu\text{F}$, $C2=1.0\mu\text{F}$, $T_{opt}=25^\circ\text{C}$)

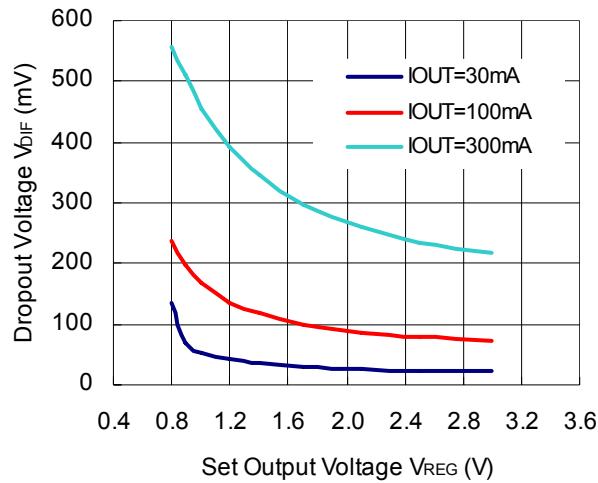
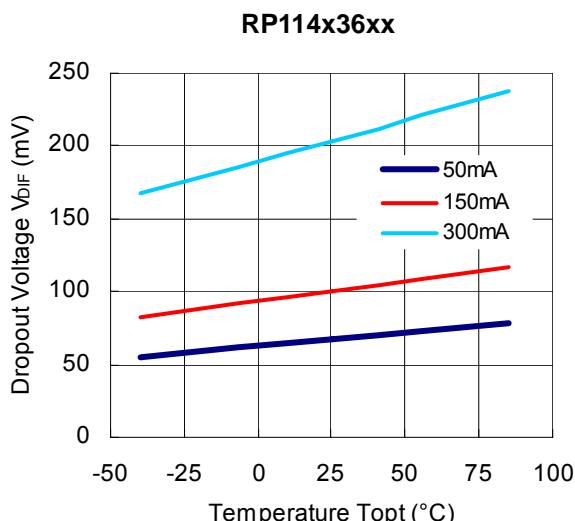
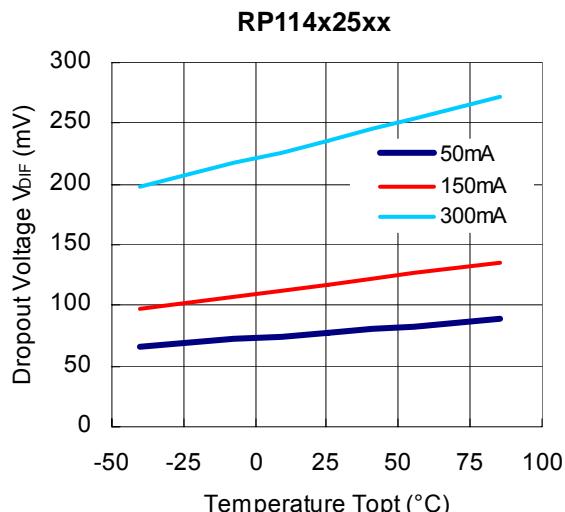
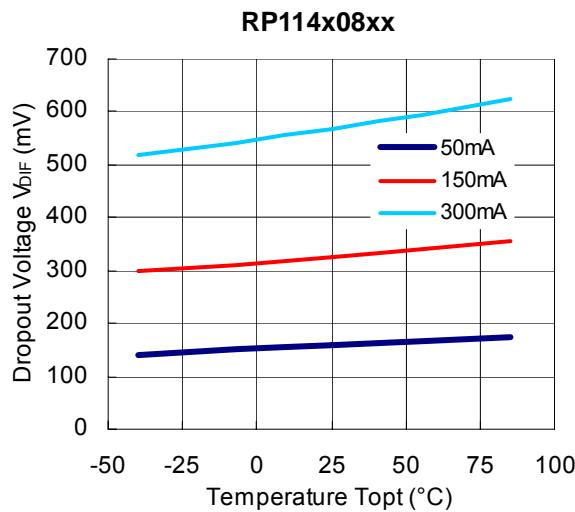


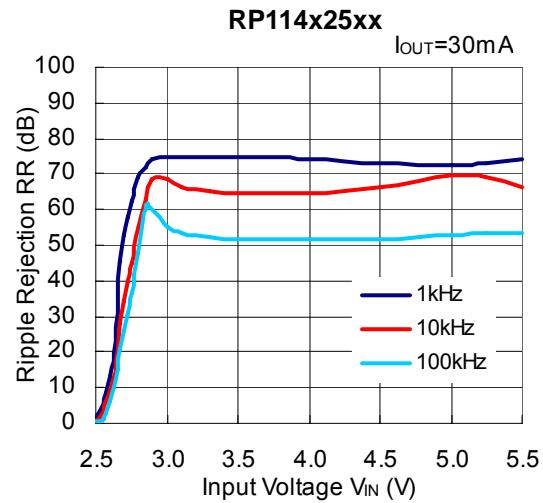
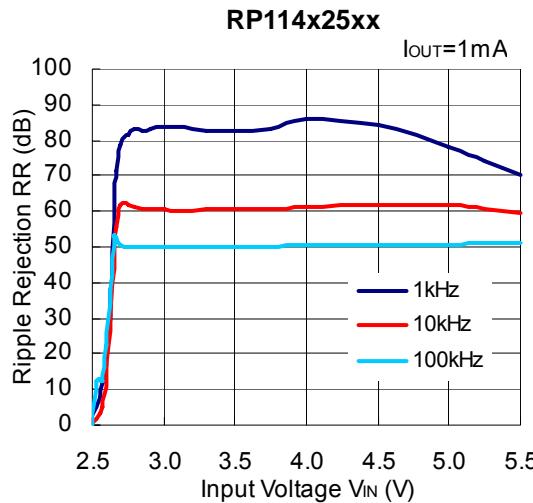
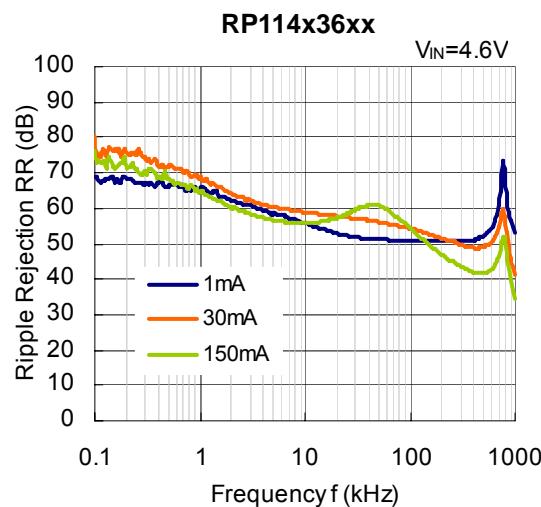
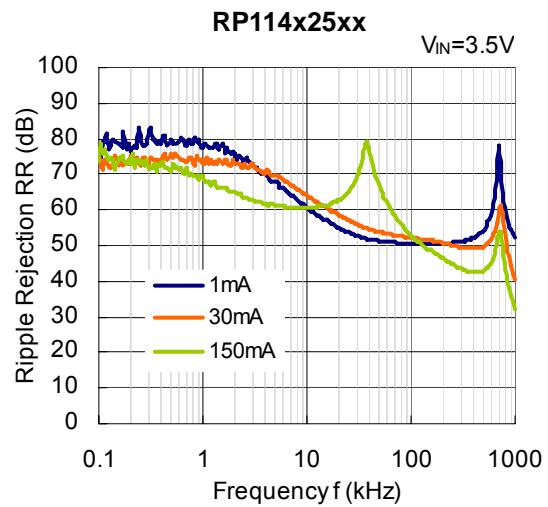
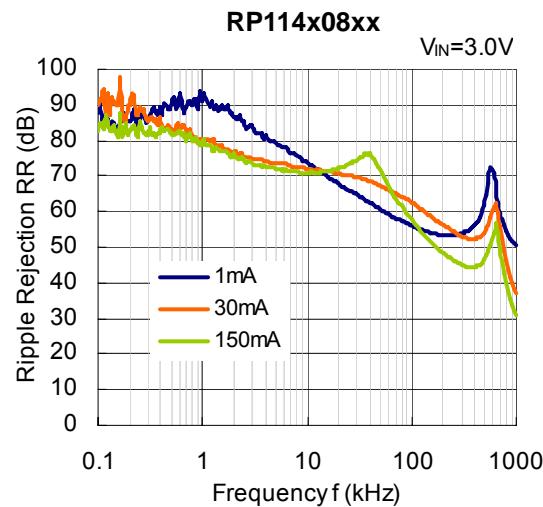
4) Output Voltage vs. Temperature (C1=1.0 μ F, C2=1.0 μ F, I_{OUT}=1mA)**5) Supply Current vs. Temperature (C1=1.0 μ F, C2=1.0 μ F, I_{OUT}=0mA)**



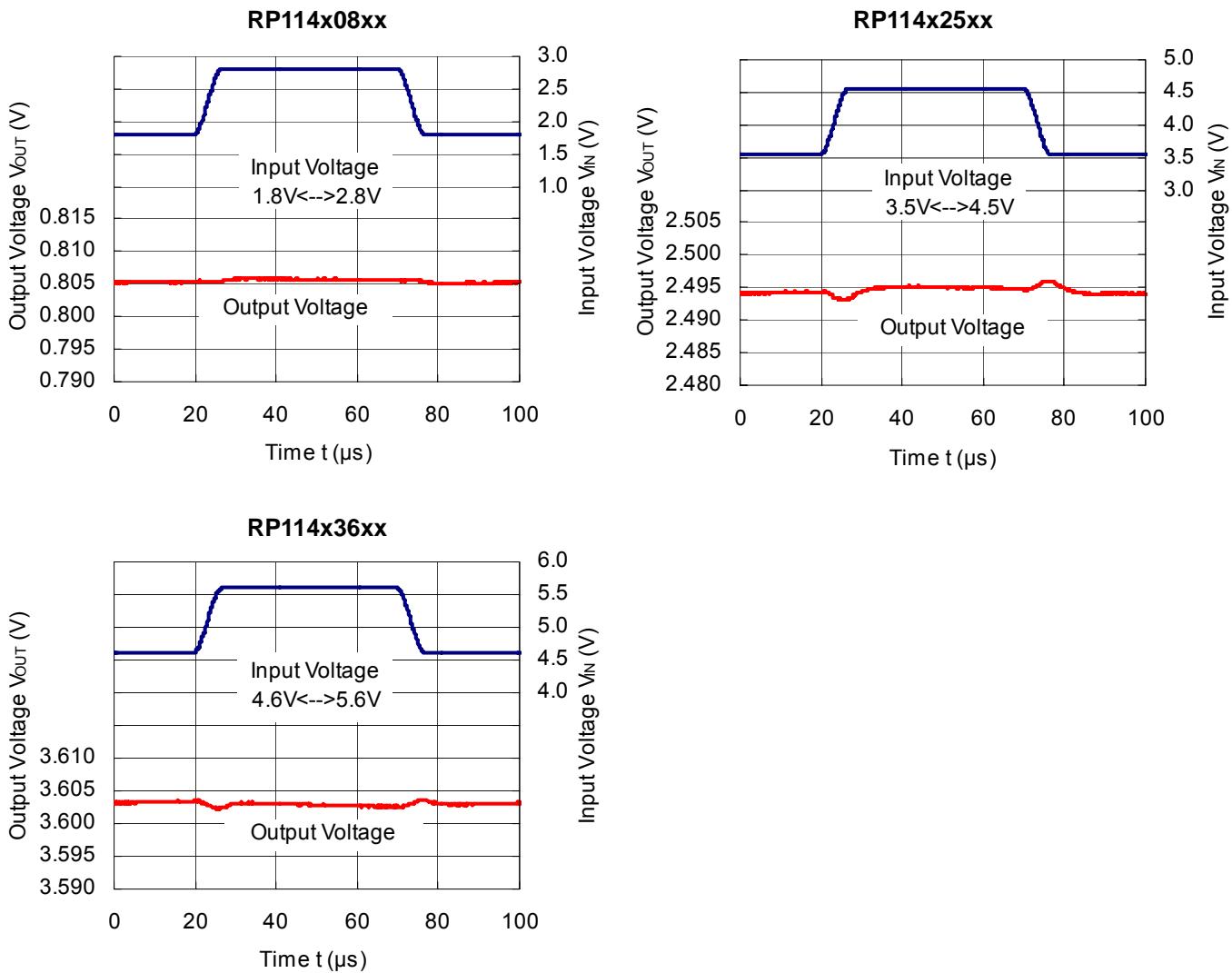
6) Dropout Voltage vs. Output Current ($C1=1.0\mu F$, $C2=1.0\mu F$)



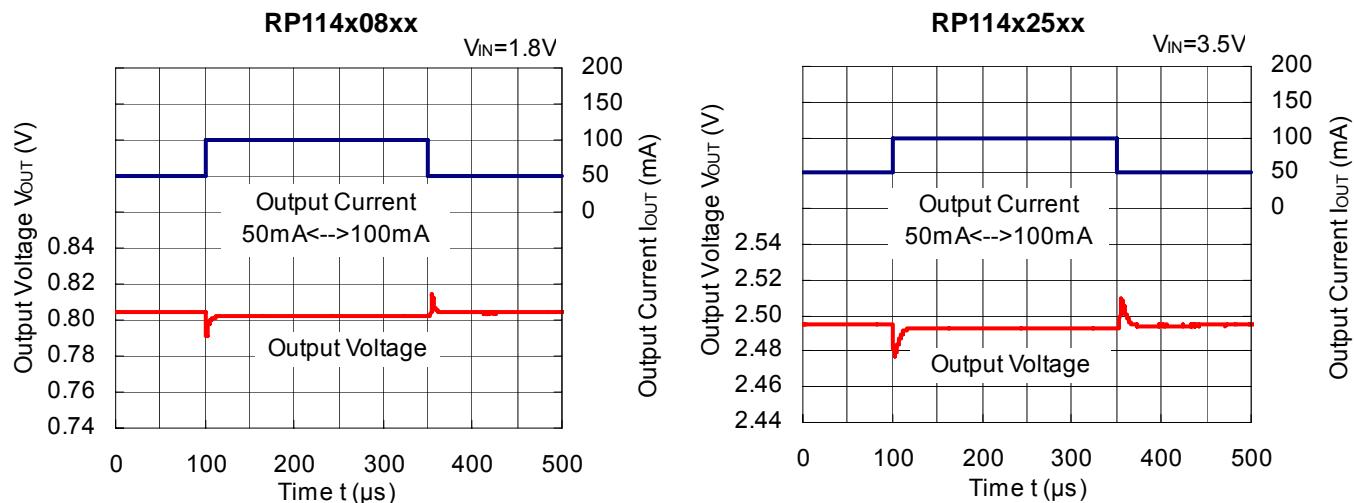
7) Dropout Voltage vs. Set Output Voltage (C1=1.0 μ F, C2=1.0 μ F, T_{opt}=25°C)**8) Dropout Voltage vs. Temperature (C1=none, C2=1.0 μ F)**

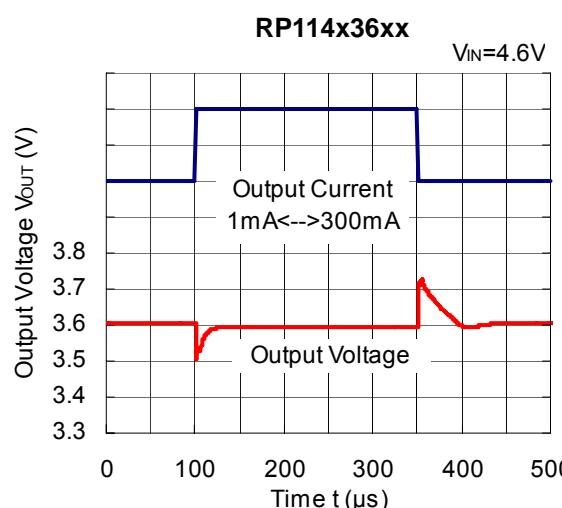
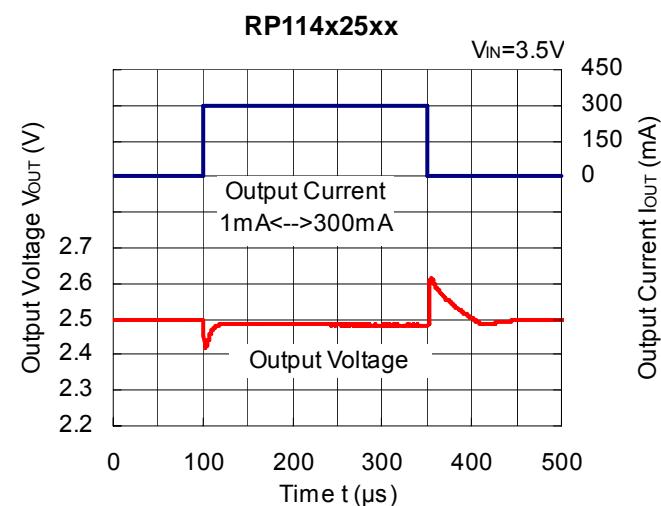
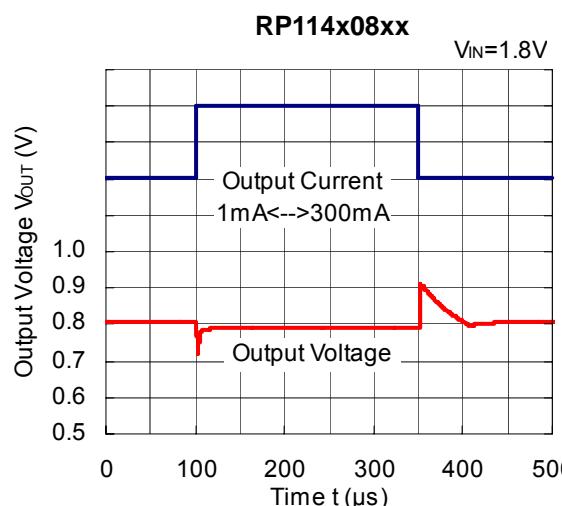
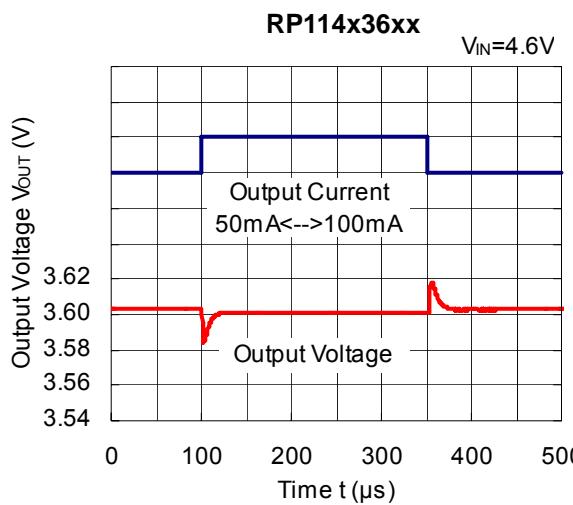
9) Ripple Rejection vs. Input Voltage (C1=none, C2=1.0 μ F, Ripple=0.2Vp-p, T_{opt}=25°C)10) Ripple Rejection vs. Frequency (C1=none, C2=1.0 μ F, T_{opt}=25°C)

11) Input Transient Response (I_{out}=30mA, tr=tr=5μs, T_{opt}=25°C)

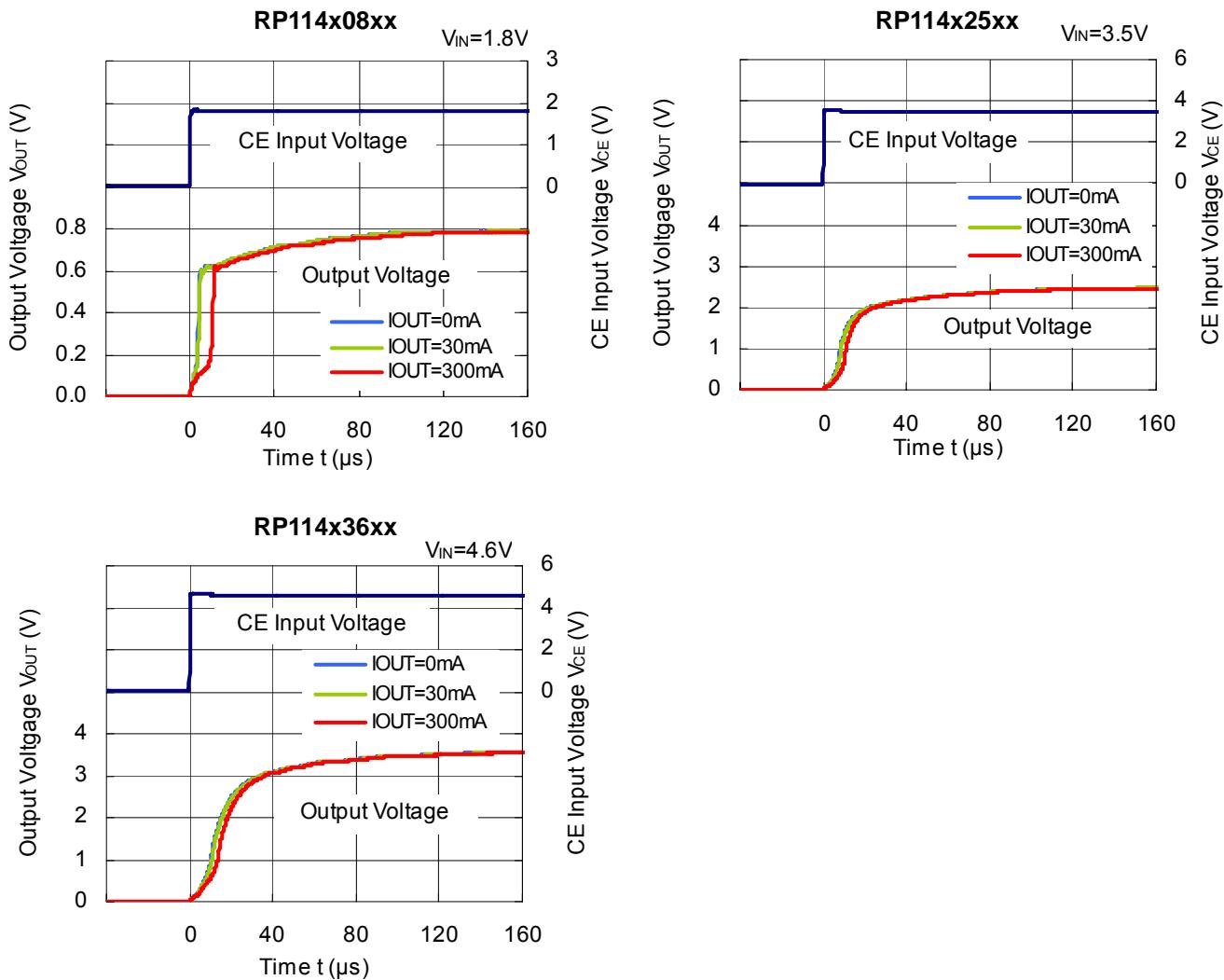


12) Load Transient Response (C₁=1.0μF, C₂=1.0μF, tr=tr=0.5μs, T_{opt}=25°C)

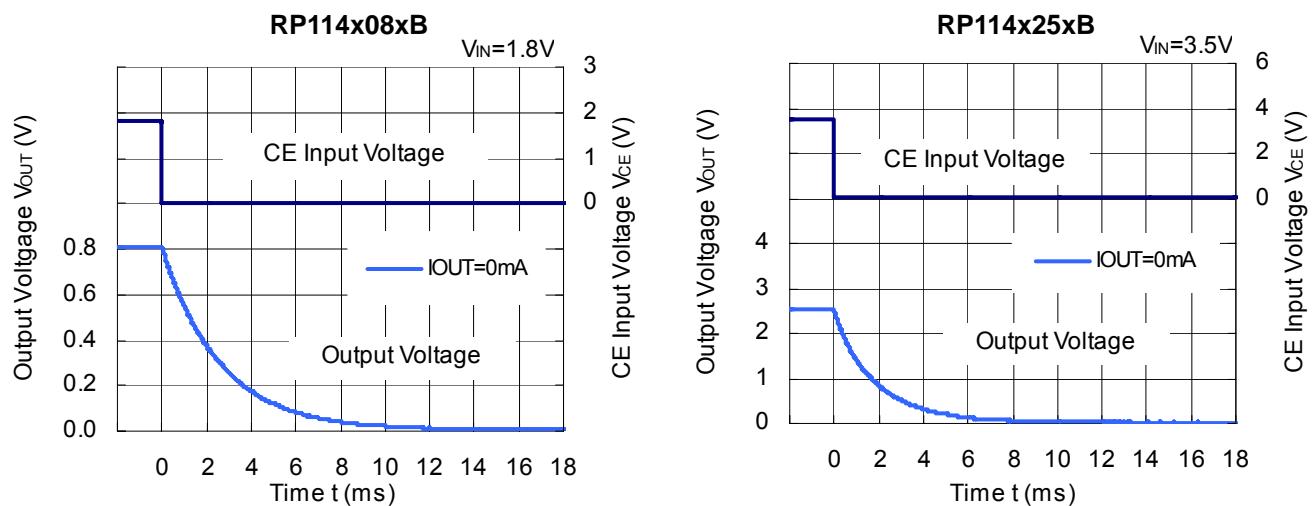


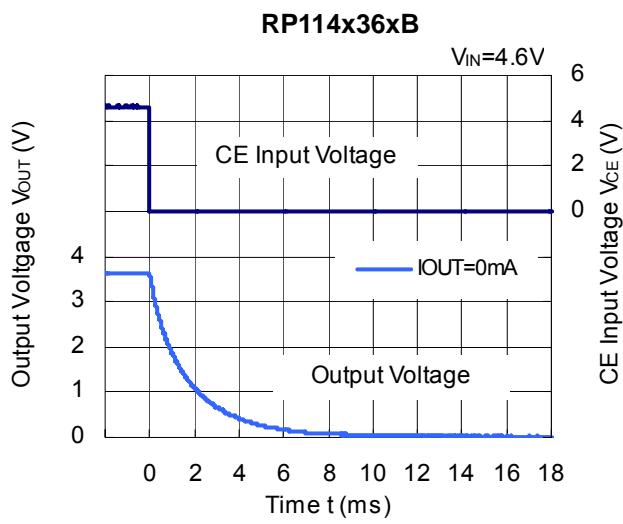


13) Turn On Speed with CE pin ($C_1=1.0\mu F$, $C_2=1.0\mu F$, $T_{opt}=25^\circ C$)

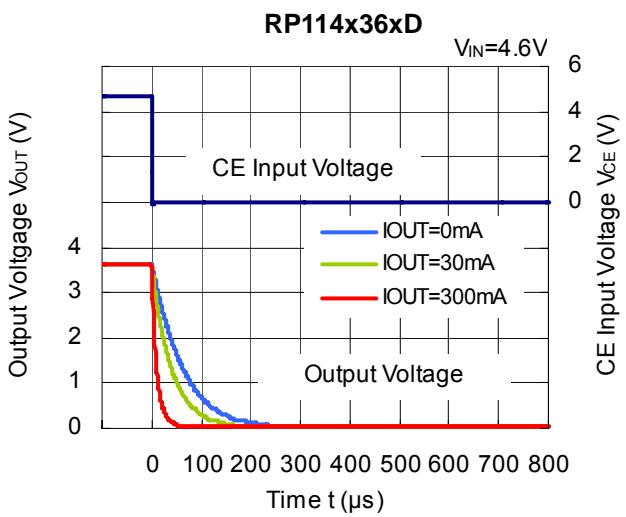
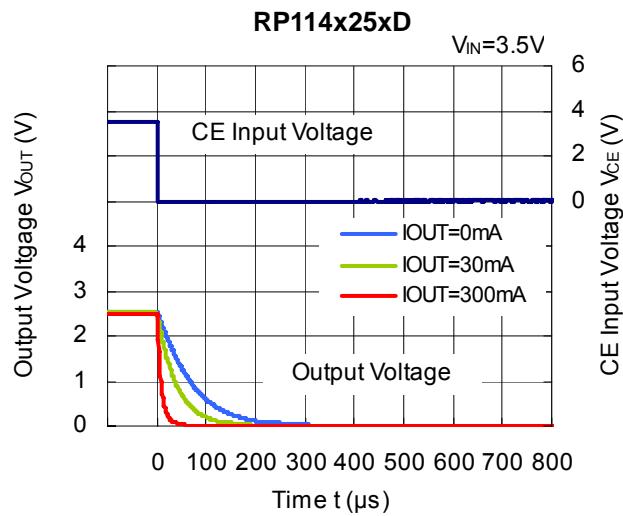
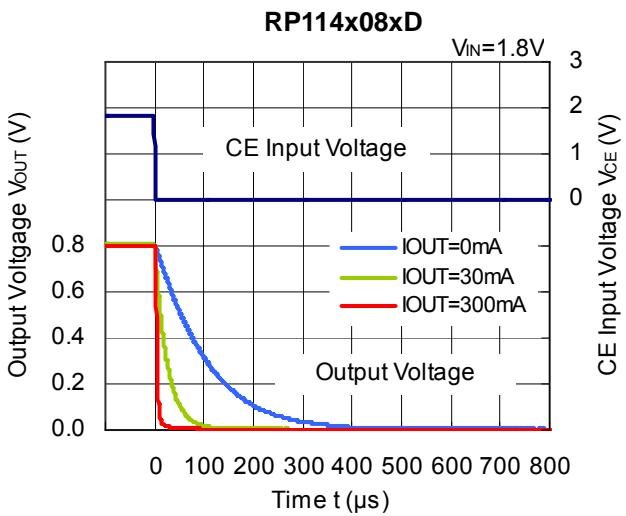


14) Turn Off Speed with CE pin (B version) ($C_1=1.0\mu F$, $C_2=1.0\mu F$, $T_{opt}=25^\circ C$)





15) Turn Off Speed with CE pin (D version) ($C1=1.0\mu F$, $C2=1.0\mu F$, $T_{opt}=25^{\circ}C$)



ESR vs. Output Current

When using these ICs, consider the following points:

The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below.

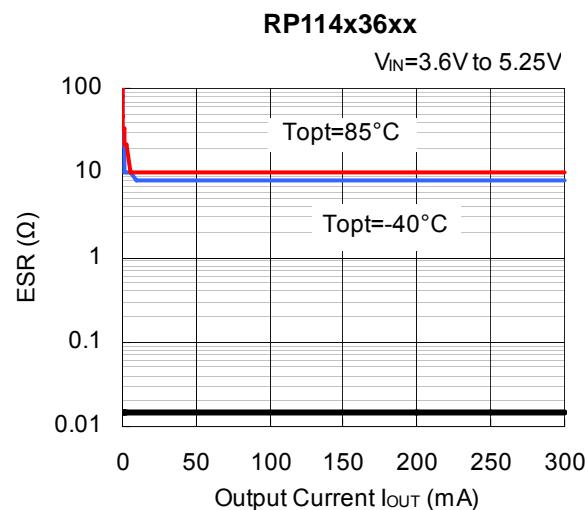
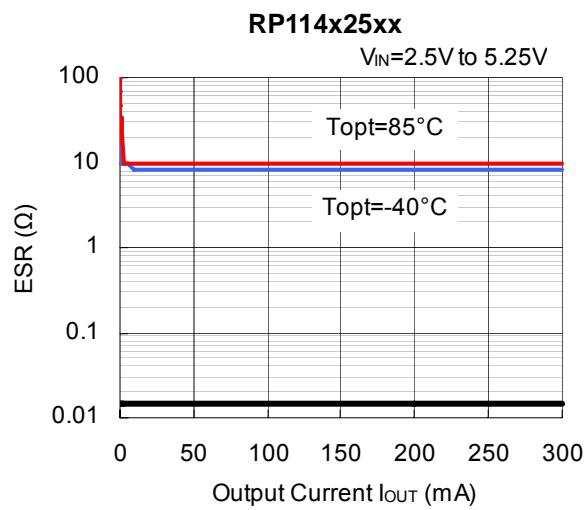
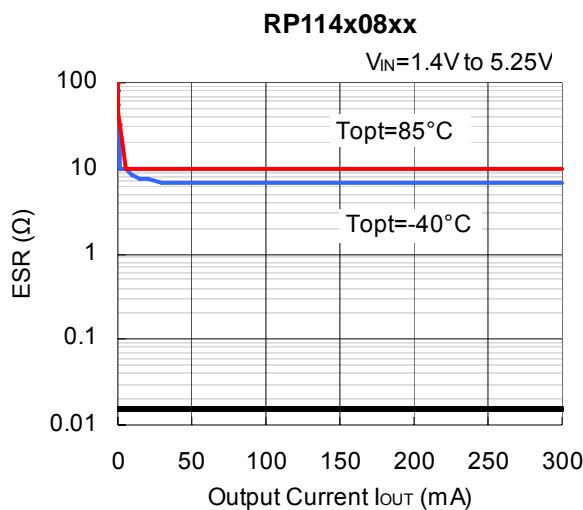
The conditions when the white noise level is under $40\mu V$ (Avg.) are marked as the hatched area in the graph.

Measurement conditions

Frequency Band: 10Hz to 2MHz

Temperature : $-40^{\circ}C$ to $85^{\circ}C$

C_1, C_2 : $1.0\mu F$





1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to Ricoh sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without prior written consent of Ricoh.
3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.
4. The technical information described in this document shows typical characteristics of and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under Ricoh's or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, firecontainment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.

RICOH COMPANY, LTD. Electronic Devices Company



■Ricoh presented with the Japan Management Quality Award for 1999.
Ricoh continually strives to promote customer satisfaction, and shares the achievements of its management quality improvement program with people and society.



■Ricoh awarded ISO 14001 certification.
The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.

<http://www.ricoh.com/LSI/>

RICOH COMPANY, LTD.

Electronic Devices Company

● Higashi-Shinagawa Office (International Sales)
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

RICOH EUROPE (NETHERLANDS) B.V.

● Semiconductor Support Centre
Prof. W.H.Keesomlaan 1, 1183 DL Amstelveen, The Netherlands
P.O.Box 114, 1180 AC Amstelveen
Phone: +31-20-5474-309 Fax: +31-20-5474-791

RICOH ELECTRONIC DEVICES KOREA Co., Ltd.

11 floor, Haesung 1 building, 942, Daechidong, Gangnamgu, Seoul, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2135-5705

RICOH ELECTRONIC DEVICES SHANGHAI Co., Ltd.
Room403, No.2 Building, 690#B1 Bo Road, Pu Dong New district, Shanghai 201203,
People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH COMPANY, LTD.
Electronic Devices Company

● Taipei office
Room109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623



Ricoh completed the organization of the Lead-free production for all of our products. After Apr. 1, 2006, we will ship out the lead free products only. Thus, all products that will be shipped from now on comply with RoHS Directive.